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(54) Title: BREATHABLE ABSORBENT ARTICLES HAVING A SILICA-BASED ODOUR CONTROL SYSTEM (57) Abstract The present invention relates to breathable absorbent articles, such as sanitary napkins and baby diapers having a breathable backsheet, and comprising an odour control system comprising silica. The combination of breathability and the odour control system deliver an improved odour control performance.		

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BREATHABLE ABSORBENT ARTICLES HAVING A SILICA BASED ODOUR CONTROL SYSTEM

Field of the Invention

The present invention relates to absorbent articles, particularly sanitary napkins and panty liners which have an improved odour control system.

Background of the Invention

Whilst the primary focus of absorbent articles, in particular sanitary napkins remains the ability of these articles to absorb and retain fluids, another important area of development in this field is the control of odorous compounds contained within the absorbed articles during their use. Malodorous compounds typically present in absorbent articles originate from a number of sources. Firstly, the actual components of the fluid discharge such as urine, perspiration, menstrual fluids, menstrual blood, and vaginal discharges may themselves contain malodorous compounds. Secondly, malodorous compounds are also generated as a result of the degradation of the components of the fluid discharge contained within the absorbent articles. Consequently, there are a wide range of compounds which may be present at some time during the use of an absorbent article which have an associated malodour. These compounds include fatty acids, ammonia, amines, sulphur containing compounds, ketones and aldehydes and numerous derivatives thereof.

The presence and detection of malodorous compounds from absorbent articles during their use, particularly those associated with menstruation may cause the wearer of these products embarrassment. Thus, the prevention of the detection of malodour from such products is highly desirable.

As a result there are numerous disclosures in the art which describe various odour compounds which provide odour control for use in absorbent articles. These odour control agents typically function by physical absorption of the odorous compound or by chemical interaction with the odorous or precursors of odorous compound or by masking the odour.

The odour control agents are typically classified according to the type of odour the agent is intended to combat. Odours may be classified as being essentially acidic, basic or neutral. Acidic odour controlling agents have a pH greater than 7 and typically include inorganic carbonates, bicarbonates, phosphates and sulphates. Basic odour controlling agents have a pH of less than 7 and include compounds such as citric acid, boric acid and maleic acid. Neutral odour controlling agents have a pH of approximately 7 such as activated carbon, clays, zeolites, silicas and starches. The typically preferred agents utilised in absorbent articles are neutral odour controlling agents and mixtures thereof. Examples of such odour control agent are disclosed for example in EPO 348 978 and EPO 510 619.

However, the above described odour control agents all have associated drawbacks. Many odour control agents do not provide effective odour control over a range of odours. Alternatively, the more effective odour control agents are expensive or such as for example with activated carbon are aesthetically unappealing to the consumer. Also, many of the odour controlling agents have problems related to their effective incorporation within the absorbent articles.

Hence, there still exists a need to provide alternative odour controlling agents or systems for effective utilization in absorbent articles. In particular, there exists a need to provide an odour control agent or system for the prevention of the detection of malodorous compounds within absorbent articles by addressing the source of the formation of the odour.

It has now been surprisingly found that the combination of a breathable absorbent article, particularly by the provision of a breathable backsheet together with an odour control system comprising silica provides an unexpected improvement in the odour control performance of the silica odour control system.

The incorporation of breathable backsheets in absorbent articles for improved wearer comfort has been described in the art such as for example in GB 2 184 389, US 3 881 489 and EPO 203 821. US 4 059 114 discloses the incorporation of antimicrobial agents in sanitary napkins which have vapour permeable backsheets. However, none of these prior art documents recognise

the benefits of the combination of a breathable absorbent article, preferably by the utilisation of a breathable backsheet with a silica odour control system.

It is believed that the synergic odour control performance benefit of a breathable absorbent article in combination with a silica odour control agent is due to a number of factors.

Firstly, the breathability of the absorbent article results in increased movement of the volatile malodorous compounds. Hence, the amount of actual physical contact between these compounds and the silica odour control agents increases. Contact between the silica odour control agents and the malodorous compounds is usually required in order to effectively combat the odorous compound. Frequently, large quantities of the odour control system is required within the absorbent article in order to ensure its effectiveness. This is because the odour control agents do not necessarily contact all the malodorous compounds. Silica however, whilst being a particularly effective odour controlling agent is expensive and thus it is desirable to avoid the necessity of large quantities of this agent. In the present invention, the effectiveness of the odour control agent is significantly increased and thus the full capacity of the silica odour control agent can be utilised and hence less silica may be required.

Secondly, the breathability of the absorbent article reduces the hot humid and anaerobic environment between the skin of the wearer and the surface of the absorbent article. This hinders the growth of microorganisms, which are also known to be responsible for the generation of odorous compounds. Thus, the amount of odours associated with the presence of microorganisms is reduced by the absorbent articles of the present invention.

Thirdly, the reduction in the hot, humid and occlusive environment between the vicinity of the skin of the wearer and the wearer facing surface of the absorbent article itself also reduces the tendency of the wearer of the product to perspire. Consequently, the amount of associated perspiration related odour will be reduced. Thus, the breathability of the article actually reduces the amount of odour generated within the absorbent article. As a result the odour control system works more effectively on the remaining odorous compounds present in the article.

In addition, due to the breathable nature of the absorbent article, the malodorous compounds contained therein may, similar to water vapour and air, be more readily exchanged with the environment. Hence, malodorous compounds are able to escape from the article and are dissipated into the surroundings. More importantly, the breathability of the article also allows the precursors compounds of malodorous compounds present in the article to escape from the absorbent article before degradation and hence before malodour formation takes place.

An additional benefit of the present invention is that the combination of breathability and silica odour control leads to an improvement in the overall dryness of the product. The breathability of the article allows for the evaporation of fluid from the article, and also as indicated above a reduction in the amount of perspiration generated by the wearer of the product and thus a reduction in hot and sweaty feelings often associated with the presence of topsheets designed to retain a clean and dry surface. The article therefore needs to retain less fluid and can do so more effectively. Furthermore, the silica odour control agents is also able to absorb fluid and thereby the improve dryness of the absorbent article.

Summary of the Invention

The present invention relates to an absorbent article, having a breathable backsheet and further comprising an odour control system comprising silica. The combination of the silica odour control system and the breathability of the absorbent article provides an unexpected improvement of the silica odour control system performance.

Detailed Description of the Invention

The present invention relates to breathable absorbent articles such as sanitary napkins, panty liners, incontinence devices and baby diapers. Typically such products comprise a liquid pervious topsheet, a backsheet and an absorbent core intermediate the topsheet and the backsheet. According to the present invention the breathability of the sanitary napkin is provided by the

presence of a breathable backsheet which thereby allows the circulation of water vapour and preferably both water vapour and air through it. According to the present invention the absorbent article further comprises an odour control system comprising silica. It has now been found that a synergy exists between the breathability of the absorbent articles and the odour control system comprising silica which results in an unexpected improvement of the performance of the silica odour control system.

Odour control system

According to the present invention the odour control system comprises as an essential component silica. Silica i.e. silicon dioxide SiO_2 exists in a variety of crystalline forms and amorphous modifications, any of which are suitable for use herein. In particular, silicas having a high surface area or in agglomerated form are preferred. Preferably the silica is in a highly purified form such that it contains at least 90%, preferably 95%, more preferably 99% silicon dioxide. Most preferably the silica is silica gel having a 100% silicon dioxide content. Alternatively the silica may be provided from other sources such as metal silicates including sodium silicate.

Preferred silica include non crystalline silica (e.g. amorphous silica, appearing as white free flowing powder), having a particle size of from 4 to 12 micrometers, a pore volume of from 1 to 2 g/ml or a granular silica of aggregated particles (e.g. silica gel, having a maximum average particle dimensions of 1.6 mm in diameter). More preferred is silica gel having a medium pore average diameter of from 4 nanometers to 15 nanometers, preferably from 6 nanometers to 13 nanometers, most preferably from 9 nanometers to 11 nanometers, a surface area of from $100\text{m}^2/\text{g}$ to $800\text{m}^2/\text{g}$, preferably from $200\text{m}^2/\text{g}$ to $550\text{m}^2/\text{g}$, most preferably from $250\text{m}^2/\text{g}$ to $350\text{m}^2/\text{g}$ and an average particle size of 15 to 200 micrometers, preferably from 63 to 200 micrometers.

The absorbent article preferably comprises a basis weight of from 40gm^{-2} to 100gm^{-2} , more preferably from 60gm^{-2} to 90gm^{-2} , most preferably from 60gm^{-2} to 65gm^{-2} of basis weight silica based on 100% purity.

According to the present invention the odour control system may comprise in addition to said silica additional odour control agents known in the art. Suitable agents include zeolites, activated carbon, clay, masking agents, absorbent gelling material, antimicrobials, chelating agents, starch, cyclodextrin, buffer systems, ion exchange resins, carboxylic acids, carbonates, bicarbonates, phosphates, sulphates or mixtures thereof.

Preferred odour control systems for use herein include the following combinations: firstly silica, AGM and zeolites, preferably in a ratio of from 5:1:1 to 1:1:5 most preferably 3:1:1 to 1:1:3. Secondly silica and AGM, preferably in a ratio of from 5:1 to 1:5, more preferably from 3:1 to 1:3. Thirdly silica and zeolites, preferably in a ratio of from 1:5 to 5:1, more preferably from 1:3 to 3:1 and finally chelating agents, particularly ethylenediamine- tetracetate, in combination with silica, AGM and zeolites.

In another preferred embodiment of the present invention, the odour control system comprises silica in close physical proximity with a zeolite within the absorbent article such as in the form of particulates, granulates, flakes, noodles and extrudates. Preferably, the silica and zeolite are in intimate admixture within the absorbent article such that they are adjacent within said particulate, granulate, flake, noodle and extrudate. Alternatively, the silica and zeolite may be present in the same particulate, granulate, flake, noodle or extrudate, but are not adjacent and are separated by one or more of the optional additional components, for example by means of at least one layer.

These odour control system may be manufactured according to conventional methods, utilising spray drying, spray mixing or agglomeration processes. According to this embodiment, in addition to the silica which in itself may acts as a binder, particularly when present as a silicate, the odour control system may comprise as optional components additional binder materials. Any binder materials used in agglomeration or spray drying techniques may be used herein for example starches, cellulose, gums, anionic and nonionic surfactants such as PEG, fatty acids, fatty alcohols, ethoxylates or any mixtures thereof. Typically, the binder will comprise at least 1%, preferably from 3% to 15%, most preferably from 4% to 10% by weight of the final particles, agglomerates or aggregates of the odour control system produced herein. The amount of binder

used can be readily determined by the skilled man and will depend on the binder material used and the desired particle size of the odour control system.

The odour control system of the present invention may be incorporated into the absorbent article by any of the methods disclosed in the art, for example, the system may be layered on the core of the absorbent material or mixed within the fibres of the absorbent core. The odour control system is preferably incorporated between two layers of cellulose tissue. Optionally the odour control system may be bonded between two cellulose tissue layers with for example a hot melt adhesive or any suitable bonding system.

The silica and optional odour control agents may be incorporated as a powder or a granulate within the absorbent article. When used in a granulate or particulate form the silica and other optional odour control agents may be granulated separately and then mixed together or granulated together.

The silica and optional odor control agent may be distributed homogeneously throughout the absorbent article or any one of the layers thereof, or may be distributed substantially in the centre of the absorbent article or substantially on the edges of the absorbent article.

According to the present invention the amount of silica odour control system incorporated into the absorbent article may be readily determined by the man skilled in the art and is to some extent dependent on the end use of the absorbent article and bearing in mind the absorbent article dimensions. Typically the absorbent article comprises from 5gm^{-2} to 400gm^{-2} , more preferably from 100gm^{-2} to 300gm^{-2} , most preferably from 150gm^{-2} to 250gm^{-2} basis weight of said odour control system. For example a sanitary napkin or panty liner may comprise from 0.25g to 5g, preferably from 0.4g to 3g, most preferably from 0.5g to 2.5g of said odour control system.

Backsheet

According to the present invention, the absorbent articles comprise as an essential component a breathable backsheet. The primary role of the breathable backsheet is to prevent the extrudes absorbed and contained in the article from

wetting articles that contact the absorbent product such as underpants, pants, pyjamas and undergarments. In order to achieved this the backsheet typically extends across the whole of the absorbent structure and may extend into and form part of or all sideflaps, side wrapping elements or wings. In addition however, the breathable backsheet permits the transfer of water vapour and preferably both water vapour and air through it and thus allows the circulation of air into and out of the backsheet and the absorbent article itself.

Suitable breathable backsheets for use herein include all breathable backsheets known in the art. In principle there are two types of breathable backsheets, single layer breathable backsheets which are breathable and impervious to liquids and backsheets having at least two layers, which in combination provide both breathability and liquid imperviousness.

Suitable single layer breathable backsheets for use herein include those described for example in GB A 2184 389, GB A 2184 390, GB A 2184 391, US 4 591 523, US 3 989 867 US 3 156 242 and European Patent Application number 95120653.1.

Suitable dual or multi layer breathable backsheets for use herein include those exemplified in US 3 881 489, US 4 341 216, US 4 713 068, US 4 818 600, EPO 203 821, EPO 710 471, EPO 710 472, European Patent Application numbers 95120647.3, 95120652.3, 95120653.1 and 96830097.0.

Particularly preferred are backsheets meeting the requirements as defined in European Patent Application number 96830343.8 and more preferably wherein the absorbent article also meets the requirements as described therein.

According to the present invention the breathable backsheet comprises at least one, preferably at least two water vapour permeable layers. Suitable water vapour permeable layers include 2 dimensional, planar micro and macro-porous films, monolithic films, macroscopically expanded films and formed apertured films. According to the present invention the apertures in said layer may be of any configuration, but are preferably spherical or oblong. The apertures may also be of varying dimensions. In a preferred embodiment the apertures are preferably evenly distributed across the entire surface of the layer, however

layers having only certain regions of the surface having apertures is also envisioned.

2 dimensional planar films as used herein have apertures having an average diameter of from 5 micrometers to 200 micrometers. Typically, 2-dimensional planar micro porous films suitable for use herein have apertures having average diameters of from 150 micrometers to 5 micrometers, preferably from 120 micrometers to 10 micrometers, most preferably from 90 micrometers to 15 micrometers. Typical 2 dimensional planar macroporous films have apertures having average diameters of from 200 micrometers to 90 micrometers. Macroscopically expanded films and formed apertured films suitable for use herein typically have apertures having diameters from 100 micrometers to 500 micrometers. Embodiments according to the present invention wherein the backsheet comprises a macroscopically expanded film or an apertured formed film, the backsheet will typically have an open area of more than 5%, preferably from 10% to 35% of the total backsheet surface area.

Suitable 2 dimensional planar layers of the backsheet may be made of any material known in the art, but are preferably manufactured from commonly available polymeric materials. Suitable materials are for example GORE-TEX (TM) or Sympatex (TM) type materials well known in the art for their application in so-called breathable clothing. Other suitable materials include XMP-1001 of Minnesota Mining and Manufacturing Company, St. Paul, Minnesota, USA. As used herein the term 2 dimensional planar layer refers to layers having a depth of less than 1mm, preferably less than 0.5mm, wherein the apertures have an average uniform diameter along their length and which do not protrude out of the plane of the layer. The apertured materials for use as a backsheet in the present invention may be produced using any of the methods known in the art such as described in EPO 293 482 and the references therein. In addition, the dimensions of the apertures produced by this method may be increased by applying a force across the plane of the backsheet layer (i.e. stretching the layer).

Suitable apertured formed films include films which have discrete apertures which extend beyond the horizontal plane of the garment facing surface of the layer towards the core thereby forming protuberances. The protuberances have

an orifice located at their terminating ends. Preferably said protuberances are of a funnel shape, similar to those described in US 3, 929,135. The apertures located within the plane and the orifices located at the terminating end of protuberance themselves maybe circular or non circular, provided the cross sectional dimension or area of the orifice at the termination of the protuberance is smaller than the cross sectional dimension or area of the aperture located within the garment facing surface of the layer. Preferably said apertured preformed films are uni directional such that they have at least substantially, if not complete one directional fluid transport towards the core. Suitable macroscopically expanded films for use herein include films as described in for example in US 637 819 and US 4 591 523.

Suitable macroscopically expanded films for use herein include films as described in for example US 4 637 819 and US 4 591 523.

Suitable monolithic films include HytreL, available from DuPont Corporation, USA, and other such materials as described in Index 93 Congress, Session 7A "Adding value to Nonwovens", J-C. Cardinal and Y. Trouilhet, DuPont de Nemours International S.A, Switzerland.

According to the present invention the backsheet may comprise in addition to said water vapour permeable layer additional backsheet layers. Said additional layers may be located on either side of said water vapour permeable layer of the backsheet. The additional layers may be of any material, such as fibrous layer or additional water vapour permeable layers.

According to the present invention the absorbent articles may further comprise a topsheet and absorbent core. The absorbent material or core which can be fluffy fibrous absorbent core comprising hydrogel particles if desired, laminated tissues with or without particulate materials including hydrogel particles. The absorbent core fibres can be any on those known in the art including cellulose fibres or polymeric fibres rendered absorbent or even non absorbent matrix fibres. Also tissues of sufficient basis weight and absorbency can be used in the absorbent core according to the present invention.

According to the present invention the topsheet may comprise a single layer or a multiplicity of layers. In a preferred embodiment the topsheet comprises a first layer which provides the user facing surface of the topsheet and a second layer between the first layer and the absorbent structure/core. The topsheet provides a layer through which the liquids to be absorbed penetrate to the absorbent material.

The topsheet as a whole and hence each layer individually needs to be compliant, soft feeling, and non-irritating to the wearer's skin. It also can have elastic characteristics allowing it to be stretched in one or two directions. Typically, the topsheet extends across the whole of the absorbent structure and can extend into and form part of or all of the preferred sideflaps, side wrapping elements or wings. According to the present invention the topsheet may be formed from any of the materials available for this purpose and known in the art, such as non woven fabrics, films or combinations of both. In a preferred embodiment of the present invention at least one of the layers of the topsheet comprises a hydrophobic, liquid permeable apertured polymeric film. Preferably, the upper layer is provided by a film material having apertures which are provided to facilitate liquid transport from the wearer facing surface towards the absorbent structure, as detailed for example in US 3 929 135, US 4 151 240, US 4 319 868, US 4 324 426, US 4 343 314 and US 4 591 523.

According to the present invention the absorbent article is constructed by joining the various elements such as topsheet, backsheet and absorbent core by any means well known in the art. For example the backsheet and/ or topsheet may be joined to the absorbent core or to each other by a continuous layer of adhesive, a patterned layer of adhesive, or an array of separate lines, spirals or spots of adhesive. Alternatively, the elements may be joined by heat bonds, pressure bonds, ultra sonic bonds, dynamic mechanical bonds or any other suitable joining means known in the art and any combination thereof. Preferably the breathable backsheet is bonded to other elements of the absorbent article so as to minimise and preferably eliminate any reduction in the vapour permeability of the backsheet.

According to the present invention the absorbent article may find utility as sanitary napkins, panty liners, adult incontinence products and baby diapers.

The present invention finds particular susceptibility as sanitary napkins and panty liners. Thus in addition to the components described herein above, the absorbent article may also comprise all those features and parts which are typical for products in the context of their intended use such as wings and side flaps, undergarment adhesive means, release paper, wrapping elements, fastening means and the like.

Example 1:

This is an example of a panty liner according to the present invention and is a modified panty liner based on Always "Alldays Duo Active" manufactured by Procter & Gamble, Germany. The topsheet is a film/non woven composite {film supplier code BPC 5105 CPM BP Chemical Germany, non woven supplier code ARBO TB/BI Mequinenza Spain}. The core material is a tissue laminate (13.2 cm x 4.0 cm) composed of a 2 layers of airlayed tissue of 55 g/m² basis weight {available from Unikay Italy under the supplier code Unikay 303 LF}. Between the two tissue layers the laminate contains an odour control system of AGM (available from DOW Chemicals Germany under the supplier code; DOW 95890.1) at a basis weight of 67 g/m², zeolite (available from Degussa Germany under the supplier code; Wessalith CS) at a basis weight of 50 g/m² and silica {available from Grace GmbH Germany under the code name Silica gel 123} at a basis weight of 50g/m².

The backsheet is a multi-layer construction composed of two layers, a first layer and second layer. The first layer directly in contact with the absorbent tissue layer is a formed apertured film (CPT) made of Low Density PE {supplied by Tredegar Film Products B.V. Holland under the manufacturing code X-1522}. The second layer or garment facing layer directly in contact with the wearers undergarment is composed of a nonwoven laminate {14MB/14SB manufactured by Corovin GmbH in Germany under the trade name MD 2005}. The nonwoven laminate is composed of 14 g/m² spunbond and 14 g/m² meltblown. Each backsheet layer is joined over the full surface by a extensively overlapped spiral glue application at a basis weight of approximately 8 g/m². The glue utilised for attachment of both backsheet layers was supplied by SAVARE' SpA. Italy (under the material code PM17).

Example 2:

Example 2 is identical to example 1 except that the second layer of the backsheet has been replaced by a nonwoven laminate composed of 16g/m² spunbond and 6 g/m² meltblown {supplied under the code of SM 22-6PH by Union SpA, Italy}.

Example 3:

This is an example of a sanitary napkin according to the present invention. The sanitary napkin is based on an Always Ultra sanitary napkin available from Procter & Gamble Germany which has been modified. The topsheet is a CPM material available from Tredgar Film Products B. V. Holland under the code X-1522. The core material is a tissue laminate (20 cm x 6.5 cm) composed of a 2 layers of airlayed tissue of 55 g/m² basis weight {available from Unikay Italy under the supplier code Unikay 303 LF}. Between the two tissue layers the laminate contains AGM (available from DOW Chemicals Germany under the supplier code; DOW 95890.1) at a basis weight of 64 g/m², a zeolite (available from Degussa Germany under the supplier code; Wessalith CS) at a basis weight of 61 g/m² and silica (available from Grace GmbH under the supplier code; Silica gel 123) at a basis weight of 87g/m². The core laminate was manufactured and supplied by Korma Italy (under the experimental manufacturing code: XA 07.001.003). The backsheet comprises two layers a first layer in contact with the absorbent tissue and the second layer, and a second layer in contact with the wearers undergarment and the first layer. The first layer is a formed apertured film backsheet layer which is a blend of low and high density PE with a crush resistant hexagonal hole configuration {supplied by Tredegar Film Products B.V. Holland under the manufacturing code AS 225 HD 25}. The second backsheet layer is an improved nonwoven laminate composed of 3 layers with basis weights 14g/m² spunbond - 20 g/m² meltblown - 14 g/m² spunbond (manufactured by Corovin GmbH in Germany under the trade name MD 3005).

WHAT IS CLAIMED IS:

1. An absorbent article comprising a liquid permeable topsheet, a breathable backsheet and an absorbent core, said core being intermediate said topsheet and said core, said absorbent article comprising an odour control system comprising silica.
2. An absorbent article according to claim 1, wherein said odour control system further comprises at least one odour control agent selected from zeolite, absorbent gelling materials, activated carbon and mixtures thereof.
3. An absorbent article according to claim 2, wherein said odour control system comprises silica and zeolite.
4. An absorbent article according to claim 2, wherein said odour control system comprises silica and absorbent gelling material.
5. An absorbent article according to claim 2, wherein said odour control system comprises silica, zeolite and absorbent gelling material.
6. An absorbent article according to either of claims 3 or 4, wherein the ratio by weight of said silica to zeolite is from 1:5 to 5:1 and the ratio by weight of said silica to said absorbent gelling material is from 1:5 to 5:1.
7. An absorbent article according to claim 3, wherein said silica and said zeolite are in close physical proximity.
8. An absorbent article according to claim 7, wherein said silica and zeolite are in close physical proximity within a particulate, granulate, flake, noodle or extrudate.
9. An absorbent article according to any one of the preceding claims, wherein said absorbent article comprises from 40gm⁻² to 100gm⁻² of said silica odour control agent

10. An absorbent article according to any one of the preceding claims, wherein said breathable backsheet comprises at least one layer selected from an apertured polymeric film or a 2-dimensional planar apertured film.
11. An absorbent article according to claim 10, wherein said layer is a 2 dimensional planar apertured layer, wherein said apertures have an average diameter of from 150 micrometers to 5 micrometers.
12. An absorbent article according to claim 10, wherein said layer is an apertured polymeric film, wherein said apertures have an average diameter of from 100 micrometers to 500 micrometers.
13. An absorbent article according to claim 10, wherein said breathable backsheet comprises at least two layers, a first layer comprising an apertured layer and a second layer comprising a fibrous layer.
14. An absorbent article according to any one of the preceding claims, wherein said article is a sanitary napkin or a panty liner.
15. An absorbent article according to claim 14, wherein said absorbent article comprises from 0.25g to 5g by weight of said odour control system

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US97/09128

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A61F 13/15, 13/20

US CL :604/359

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. 604/359

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,826,497 A (MARCUS et al.) 02 May 1989, col. 3, line 63 to col. 8, line 50.	1-15
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Y		1-15
Y	US 3,881,489 A (HARTWELL et al) 06 May 1975, Abstract.	1-15
A	US 4,341,216 A (OBENOUR) 27 July 1982, entire document.	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
A document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
E earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*G* document member of the same patent family
O document referring to an oral disclosure, use, exhibition or other means	
P document published prior to the international filing date but later than the priority date claimed	

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